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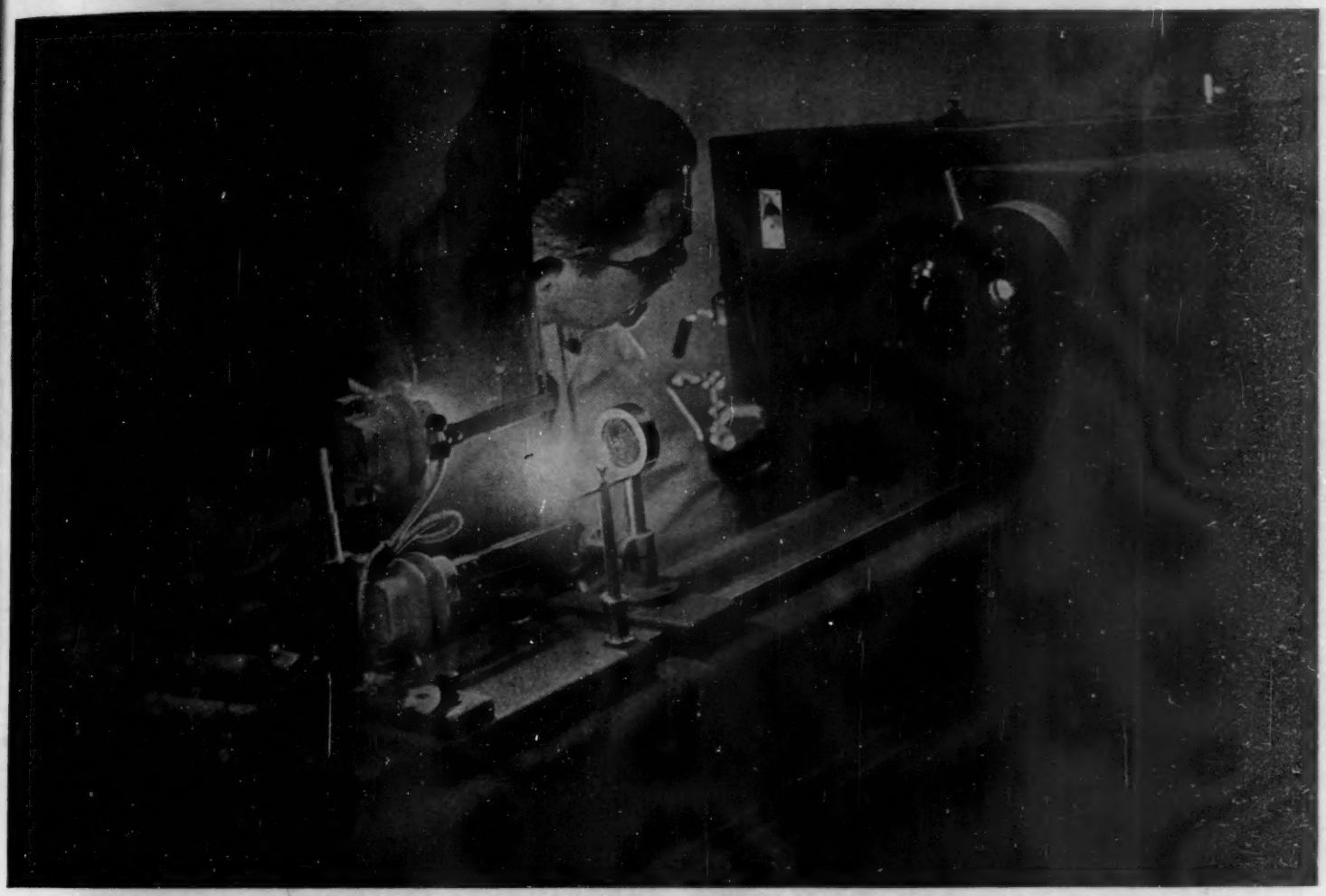

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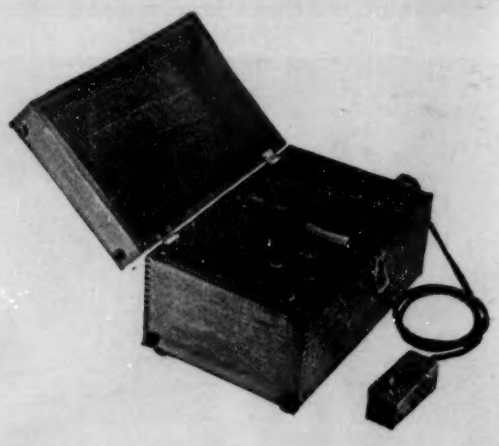

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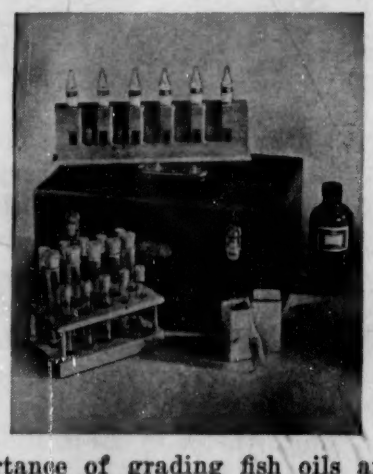

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VOL. 98 FRIDAY, DECEMBER 17, 1943 No. 2555

American Learning When Peace Comes. "The Natural Sciences": DR. GEORGE GLOCKLER 525

Obituary:
Edward Burr Van Vleck: PROFESSOR RUDOLPH E. LANGER. *George West Graves:* PROFESSOR LEO F. HADSALL. *Recent Deaths* 530

Scientific Events:
Scientific and Technological Training in Great Britain; Rubber from Russian Dandelions; Finances of the University of Illinois; The World Map of the National Geographic Magazine; The Dr. William Beaumont Foundation; The American Pharmaceutical Manufacturers' Association 532

Scientific Notes and News 534

Discussion:
Statistical Treatment of Percentage Counts: DR. F. M. WADLEY. *The Germination of Dormant Lettuce Seed:* PROFESSOR G. J. RALEIGH. *Some Misleading Terminologies in the Literature of "Plant Tissue Culture":* PROFESSOR I. W. BAILEY. *Relative Values for Descriptive Words:* DR. O. N. LIMING 536

Scientific Books:
Nutrition: PROFESSOR H. J. DEUEL, JR. *Aerial Photographs:* DR. WALTER CLARK 540

Special Articles:
The Antigenicity of Protein Isolated from Bovine Serum After Brief Treatment with Alkali: DR. RALPH J. DEFALCO, DR. LOUIS A. KAZAL and DR. L. EARLE ARNOW. *A Physical Deficiency in the Ration of Ruminants:* PROFESSOR H. H. COLE and PROFESSOR S. W. MEAD. *The Culture of Young Conifer Embryos in Vitro:* S. W. LOO and F. H. WANG 542

Scientific Apparatus and Laboratory Methods:
Hematocrit Determination of Relative Cell Volume: DR. ARTHUR K. PARPART and R. BALLENTINE. *Simple Adapters for Continuous Extraction of Aqueous Solutions in the Soxhlet Extractor:* DR. BERNARD S. GOULD 545

Science News 10

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AMERICAN LEARNING WHEN PEACE COMES. "THE NATURAL SCIENCES"[1]

By Dr. GEORGE GLOCKLER

THE STATE UNIVERSITY OF IOWA

IN a consideration of the topic of American scientific learning in the post-war world, it must be understood that perhaps no other fields of human endeavor are as international in scope and attitude as are the natural sciences—astronomy, biology, botany, chemistry, geology, mathematics and physics. A great deal that can be said concerning these subjects goes far beyond the limits of national boundaries and is of importance to all human beings. However, it appears definitely worth while to consider specifically the problems of American scientific learning when peace comes so that the contributions to the natural sciences which must be made and, it may be predicted, will be made, by American scholars and workers, can be seen at least in outline and can serve as a goal to be attained. The problem of American scientific learning will be discussed on the basis of three factors: the world background as seen by scientific men, the basic qualities of the human intellect, curiosity and imagination, upon which depends all progress in the natural sciences, and the special tasks which American scientists must face in so far as these problems concern the position and growth of American scientific learning in the period following the present conflict.

In an endeavor to consider these questions one might well insist that the only problem of importance at the moment must be the winning of this global war, since failure in this task would make irrelevant any further discussion concerning the position of American scientific learning when peace comes once again. But such a negative attitude would certainly lead to no improvement in the lot of humankind and a more sensible, in fact, a desperately necessary view is to

[1] This is the second of a series of ten Baconian Lectures given under the auspices of the Baconian Club, State University of Iowa, Iowa City, Iowa, on October 8, 1943.

bring the problems confronting all peoples after the war into the light now, so that the future of mankind may be established on a more logical basis than has been done in the past. Will the human race have to go through an abyss of darkness, which is war, at periodic intervals; or is there hope that a new and more abundant civilization can appear on the surface of this earth? Scientifically trained men believe that the economic basis of human existence on this planet will be so profoundly affected by future scientific learning, discovery and invention and the subsequent repercussions in the economic sphere will be of such magnitude, that an age of plenty will be initiated where the present economic and political struggles between empires will tend to disappear. Perhaps no individual can offer at this moment a reasonable solution of current international difficulties as long as millions of people need food and clothing of which there is a scarcity. War and strife may be inevitable in a world in which 50 per cent. of the wealth is enjoyed by about 6 per cent. of the population. It is to be hoped that future generations will solve the problem of the distribution of wealth on a more equitable basis so that they may look back upon the present period with horror and unbelief, wondering how the social and economic injustices of to-day could ever have been perpetrated by so-called human beings. Mankind may well pray that future economic systems will not involve the existence of want in a world of plenty. May future generations learn to use the God-given abundance of this earth with wisdom and consideration for all, so that they need not curtail production while there is still want. Scientists may hope that their work and efforts will lead to a continued increase in the usable physical wealth of the world. They believe this enrichment will lead to a steady improvement in the relationships of nations, so that contending groups may gradually acquire knowledge of a proper basis for living together, just as individuals have found a way of cooperating in a society. Surely nations will learn to live and let live and some day evolve a system of association free from mistrust and suspicion and thus really attain more closely the ideal of the Golden Rule.

Hence the basic thought of this thesis is that a better world civilization will be possible because the economic foundation of human existence will be profoundly altered by future scientific discovery and invention. More of the world's goods will be produced at less cost to all through scientific research. Scientific thought and learning are the very foundation on which the progress just outlined must be built. Great strides have already been made, but an enormous amount of work must be done to create a world based on greater abundance.

For the further analysis of scientific learning it is necessary to discuss the second point of this theme; namely, the two qualities of the intellect, curiosity and imagination, which are fundamental so far as science is concerned. On this basis it is possible to understand past performance and whatever future progress may be expected in the realm of scientific study and research. The present-day sciences would never have been established had there not been individuals with abounding curiosity who were willing to overcome their inherent laziness and spend time and effort, without thought of reward, in order to learn about the physical universe surrounding them. However, an inquiring mind alone would never have produced the present edifice of scientific knowledge had it not been coupled with productive imagination. The latter is the most important quality of the human intellect in relation to the advancement of scientific learning.

It is an enticing exercise to let the imagination take its flight into the future and to attempt to visualize the world of to-morrow as conceived by the scientist of to-day. The basis of this projected thought picture, must, however, be the performance of the past, so that the description rendered may not take on the cloak of ridiculous fancy nor the shape of naive fallacy. Nevertheless, errors of too great conservatism must equally well be avoided. If the advances in the natural sciences for the last few decades are considered in retrospect, it is clearly seen that the possibilities of the future are great. It is to be hoped that the picture on the whole can be an optimistic one and the consensus of opinion of scientists warrants indeed a promising outlook in spite of the dreadful events which hold men chained at present to undertakings completely destructive and utterly senseless on any rational basis.

Because psychology is the science concerned with the systematic investigation of the mind and since imagination refers to a certain category of the functions of the human intellect, it is natural that the psychologist should render an analysis of the imaginative mental process. In the early history of psychology imagination was simply defined as the ability of having mental images or pictures. However, very soon a distinction was made between the mental activity of recalling images of earlier experiences, now called reproductive imagination or memory, and the formation of new mental pictures from a combination of already known ones. This latter performance can be called productive imagination, and it is this faculty which is of interest at the moment. The imaginative exercise may be defined as the process of conjuring new mental patterns from the background of experience. The verb, conjure, is used advisedly because of its usual reference to the practise of magic.

Productive scientific imagination is certainly mental magic in the realm of scientific possibility. The sequence of mental steps involved in creative scientific thinking leads to the formation of new and hence unexperienced pictures and ideas. These new constructs of the mind must in the case of the natural sciences remain within the framework of scientific law. Hence they can not be pure fantasy. However, an audacious spirit, not too hampered by conservatism, will lead the way to further achievement. Time and again discoveries and inventions have been announced which have reached beyond the wildest flights of the imagination of even the most daring dreamers of an earlier day. It must be said that imagination is the most far-reaching power in all the world. Creative imagination lies at the basis of every great achievement accomplished by man. The minds of all the great explorers were filled with imagination. These men were consumed by a burning desire to find out what was hidden beyond the geographic horizon. This country, this America, was at one time but a dream in the mind of a Viking discoverer. This university was but a picture on the mental canvas of its founders. Does any one doubt that these men of 1850, could they be here to-day, would be amazed beyond measure to see this edifice of learning? Can it be believed that ninety years ago, they could have imagined this great institution as it is to-day? One instinctively feels that their ability to visualize the future could not have been daring enough to portray what really exists here now. Need then the scientist be timid or afraid in his own contemplations of the future? Surely after looking about and seeing the accomplishments of the human race up to the present, he may throw caution to the winds and soar into the future with all the daring enthusiasm he can summon!

It is obvious that imaginative thought is important in all fields of human endeavor. Not only does the geographic horizon incite the mind to wonder what lies beyond and, being based on visual stimuli, conjure up pictures of places and peoples strange to one's actual knowledge, but also other stimuli may arouse the imagination. One type of sense experience either perceived or remembered can be the impetus to imaginative thought processes involving fruitful speculation in other directions. A picture or a painting may give rise to the stirring of the imagination as also may a play or a book. Worlds of thought and fancy may arise in the mind from a poem heard and remembered. One truly marvels at the complexity of the imaginative process!

Turning now to the third point of this thesis, namely, the special tasks of American scientists when peace comes, it is evident that they must direct their thoughts and energies to the problems of a war-weary world. Clearly America must play an important and guiding role in the rehabilitation of the stricken peoples of this earth. A note of warning seems necessary, for it must be realized that this nation is using up its physical wealth in fuel, metals, forests and soil unstintingly at a truly alarming rate. It is certainly questionable whether or not this continent can feed all the war-torn populations. Hence, from the point of view of the dwindling resources of this country, the possibility must be borne in mind that the United States may also become a "have not nation." Her scientists will then be confronted with new problems of inventing substitutes for materials of which there is no longer an abundance. No doubt their ingenuity and imagination will bring forth a multitude of new products which will in turn initiate unforeseen developments in every phase of human endeavor.

It is indeed a fascinating undertaking to revel in predictions concerning the state of things to come in the near future. In astronomy it may be expected that the two-hundred inch telescope at Mt. Palomar will be finished and put into operation, opening new vistas of the cosmos to closer scrutiny. The Schmidt telescope and camera will very likely be constructed and should rival the two-hundred-inch instrument in power and possibilities. Astrophysicists will make further progress in their field. The age-old question of the origin of the solar system may be solved by an acceptable theory. The newer ideas indicating that solar energy arises from a series of nuclear transformations will be further discussed and developed. On the practical side astronomy will further improve the method of marine and aerial navigation. Already a tenfold increase in precision of time measurement has been made since World War I, and further advances along these lines will lead to even better control of ships and planes.

The physicist will undoubtedly carry on his investigations of the decomposition of the nucleus of Uranium isotope 235, and the tremendous amounts of power released from this fission of an atomic nucleus may be harnessed. A new form of available energy would thereby be created surpassing present means of procuring work from coal, oil and waterfalls. Even now, the warring nations, including the United States, are said to expend vast sums of money in research along these lines, to be sure at the moment directed towards the destructive purposes of war. Should it be possible to carry out this age-old dream of taming the enormous energies hidden in the atom, a new era of technology would undoubtedly be initiated.

In connection with possible power developments one can not forget the suggestion of obtaining energy from the sun by direct means, instead of depending on accumulated stores such as petroleum and coal.

Simple solar heaters have been used for decades, but large-scale units are only in the blue print stage. So far coal and oil have furnished power for industrial use more economically. The post-war period will need power projects not dependent on dwindling resources. Energy equal to twenty-one billion tons of coal which the sun showers on the surface of the globe every hour offers fascinating possibilities. At the moment the difficulty is one of expense, since large and costly installations would be needed to convert solar energy directly into useful forms. But to-morrow's reality is woven from the dream fabric of to-day! Imagine that Icarus of Greek mythology could come to life and observe the modern aeroplane! Would he not admit that reality had reached beyond his wildest visions? May it be hoped that the human spirit still possesses similar daring and adventure!

After the war American physicists will be able to return to their atom-smashing machines and obtain further information regarding the atomic nucleus. The electron microscope will bring molecules of matter into the field of direct observation. Instead of magnifications of the order of 5,000, as obtained with the ordinary microscope using visible light, magnifications of the order of twenty to fifty thousand are even now possible by substituting electrons for radiation and by replacing lenses by electric and magnetic fields. Already very large molecules have been photographed and the progress that can be imagined by further improvement of the electron microscope is really breath-taking. Had any one, only twenty years ago, mentioned the possibility that molecules can be seen, he would have had his reason questioned, for the idea is utterly fantastic and preposterous to any one acquainted only with the ordinary microscope and unaware of the possibility of substituting electron stream for light beams. More detailed knowledge of matter in exceedingly small dimensions or on the level of molecular size will bring great technical improvements in manufacturing processes.

The biologists will continue their studies of the living cell, especially from the point of view of physical chemistry. No research group is required to have a larger background of learning than does the scientist who interests himself in the phenomenon of life. The complex structures of living organisms appear to be the culmination of all natural processes known to mankind. Life seems to be the highest form of creation, certainly when considered on the basis of complexity and intricate composition, as well as in breadth of function. Hence, it is not to be wondered at that scientists have not yet learned the secret of life. However, biologists will persist in their tasks and they will undoubtedly make the most far-reaching contributions to scientific learning not only in the post-war period but also in the more distant future, especially in the field of genetics, which will be of immense value to the human race in numberless directions. Of greatest immediate importance appears to be the study of molds and yeasts which may well revolutionize the world's food situation. Yeasts can be grown in a nutrient medium and they will there reproduce themselves very rapidly. Recent researches in this country show that molasses, ammonia gas, water, air and yeast may be mixed in large tanks where the yeast will grow to furnish an edible material rich in proteins and vitamins. It is entirely feasible that this biochemical method may become a serious competitor to our cattle raisers in the matter of furnishing protein foods for the nation. Flavors can be synthesized by the chemists making the yeast-cake more palatable. Furthermore, the biologist and geneticist are already developing various strains of yeasts yielding materials of different tastes. Enthusiasts visualize a new method of food production, more economical and less cumbersome and adaptable to the crowded regions of the globe. The program is now in its initial stages, and no doubt great developments may be expected in the very near future. Mankind has used yeasts as food for centuries in bread and ale, but these newer researches will give these lowly molds an entirely new role in human nutrition.

It should be noted, however, that, after all, the yeast cells must eat and the sugar or molasses must still be obtained from vegetation. As long as the chemist is unable to carry out photosynthesis in test-tubes, it will be necessary for the botanist and plant geneticist to continue their labors and produce for human consumption ever greater varieties of plants. The amazing performance of hybrid corn is too well known to be discussed in detail. Similar and equally startling developments are just beyond the horizon. From the plant kingdom is obtained cellulose, perhaps the most versatile material in technological use. Just as the past century has been called "the age of steel," so it has been predicted that the coming era will be called "the age of cellulose." If present demands on the iron ore deposits of this country continue for any length of time, there is no doubt that a serious metal shortage will have to be faced and many articles of commerce will be made from synthetic lumber or artificial wood derived from cellulose specially grown for this purpose under the guiding hand of the botanist and treated by the chemist for its varied uses. Moreover, cellulose when digested with water and acids changes into starch-like materials and sugar-like substances which have nutrient value and can serve as food. This wonderful substance in the form of lumber can

house man; in the form of cotton and rayon, it can clothe him, and after chemical treatment, it can serve as his food!

The thought just expressed, that the present metal economy may be changed as the natural resources of this country dwindle, leads to the consideration of possible new supplies and how to find them. Geology in one of its aspects is responsible for the fundamental knowledge which is necessary for the discovery of new deposits of oils and minerals. While it is easy to picture the coming period as the age of flight, where every American family will own its model T helicopter, it remains to be seen where the gasoline is to come from to lift the whole nation into the air and move it at great speed through the clouds. The planes can be built from plywood if necessary, but where the fuel is to be obtained—that is another question! No doubt geologists using refined methods of detection as improved by geophysicists will be able to discover new oil fields, but the process can not go on indefinitely, and some day this nation will have to use its shale deposits and rely on the synthetic fuels obtained by chemists from the hydrogenation of coal. Luckily there exist within the borders of the United States enormous deposits of low-grade coal, which by chemical methods may be made to yield fuels needed to replace the natural petroleum. The dream of an air-age must be scrutinized carefully on the basis of the fuel economy if it is not to be mere fantasy. As in the case of petroleum, the advances made by the physicists in the use of short-wave radio equipment may also help the mineralogist in the discovery of new deposits. However, such ore developments may happen in other regions of the globe, as yet not as well explored as the land-mass of this continent. Large deposits of high-grade iron ore are known to exist in South America. The oceans may have to step into the picture and furnish light metals as is now the case with magnesium. The American geologist has a serious task to perform if this nation is to maintain its preeminent position as an industrial power. In its more theroetical aspects as a branch of scientific learning, geology in its many divisions will make its contributions to the advancement of human thought in the post-war period as it has done in the past.

Turning now to the chemistry of to-morrow, it can be said that a similar vista of new and startling developments can be expected in the realm of chemical learning. No doubt chemists will continue their studies of the structure of molecules, they will obtain more satisfactory knowledge of reaction mechanisms, and they will make further progress along the present line of theoretical chemical thought. The impact of this advance in fundamental chemical information on the applied field will be indicated in the improvement which is expected in chemical technology. The time interval between the discovery of new scientific knowledge and its application in industry is ever being shortened and, furthermore, industrial research laboratories themselves are turning their attention to basic theoretical investigations in their own respective fields. This great mass of scientific learning will make it possible for American chemists to furnish to the economy of the nation the prerequisite power resources and materials needed by industry. The problem of substitutes will be ever more important, and synthetic rubber and plastics will have an even more significant role to play in the post-war period than they do now. A greater variety of artificial fibers such as rayon and nylon will be produced; new types of glassware like pyrex will be available; more powerful fuels will drive the engines of to-morrow, and the light metals, aluminum and magnesium, will find enormously greater industrial uses. The most spectacular and important progress, however, is predicted in the fields of biochemistry and chemotherapy. Every one now knows of sulfa-drugs and of penicillin. The latter is obtained from a lowly mold and has remarkable therapeutic value. No doubt chemists will isolate, analyze and synthesize the active substance, and make it available to the public at reasonable cost. Another newcomer is clavacin, from a different mold, which may be even more remarkable in its ability to kill bacteria than is penicillin. Vitamin research will continue, and in the field of immunization it may be expected that antibodies will be prepared in glass flasks instead of obtaining them from animals in the present tedious way. Advances in scientific knowledge will be made along all lines of scientific endeavor. It must be realized that the various fields of human learning are so complex and interrelated that progress in one goes hand in hand with advancement in another.

Newer concepts in mathematics make it possible for the physicist to evolve a new theory of the atom, which induces the chemist in turn to change his ideas of chemical combination. No natural scientist, be he biologist, botanist, physicist or chemist, can hope to keep abreast in his field of learning without a thorough knowledge of related topics and especially of mathematics. The queen of the sciences rules the domain of scientific learning, but for homage paid, she gives great return. No category of human thought affords greater satisfaction than the ability to state logical propositions in terms of mathematical symbols, and to arrive at exact conclusions by mathematical operations. Mathematics is the universal scientific language, and any nation neglecting this subject will lose its place in post-war competition. By the same token it is necessary to find those individuals of the younger generations who have the God-given aptitude

to become the scientists of to-morrow, so that they may carry on the torch of scientific learning. Were it possible to settle the problems of mankind on a rational basis rather than on the present emotional plane, the world of to-morrow would be a better place to live in.

The scientist has hope. Even though he now looks upon a distorted world of victor and vanquished, he knows that real progress will be made, for in his imagination he sees a future which will be an improvement over the past.

In chapter twenty-one of Revelations it is written of the future of a new Jerusalem:

> And the building of the wall of it was of jasper, and the city was pure gold, like unto clear glass.
>
> And the foundations of the wall of the city were garnished with all manner of precious stones. The first foundation was jasper; the second, sapphire; the third chalcedony; the fourth an emerald; the fifth sardonyx; the sixth sardius; the seventh chrysolyte; the eighth beryl; the ninth a topaz; the tenth a chrysoprasus; the eleventh a jacinth; the twelfth an amethyst.
>
> And the twelve gates were twelve pearls; every several gate was of one pearl and the street of the city was of pure gold as it were transparent glass.

Should scientists accept these scriptures as a challenge? If not taken too literally, they have already done so.

An old Chinese philosopher has said of a gentleman: "To see clearly; to understand what he hears; to be warm in manner; dignified in bearing; faithful in speech; painstaking in his work; to ask when in doubt; in anger to think of difficulties; in sight of gain to think of right!"

All these qualities scientific men must possess and one more—imagination! With the ability of creative thought applied to their fields, scientists will transform the world!

OBITUARY

EDWARD BURR VAN VLECK
1863–1943

ON June 2, 1943, a leading figure was plucked from the ranks of American scholars, and especially from those of American mathematicians, through the death of Edward Burr Van Vleck.

Professor Van Vleck was born at Middletown, Conn., on June 7, 1863, the son of John Munroe and Ellen Maria (Burr) Van Vleck. His college training he received at Wesleyan University, Conn., from which he graduated in 1884. His graduate studies in mathematics and physics he pursued at the Johns Hopkins University from 1884–87, and, after an interim during which he served as an instructor at his Alma Mater, at the University of Göttingen, Germany, from which he received the doctorate in 1893.

Professor Van Vleck's period of activity as a teacher and mathematical investigator may be regarded as having properly begun with his acceptance of an instructorship at the University of Wisconsin in 1893. Simultaneously with this he took membership in the American Mathematical Society, and thereby actively affiliated himself with that group of young scholars whose enthusiasm and attainments were largely instrumental in establishing in America mathematical standards and research comparable with those of Europe. Of this group he was one of the first to make his home in the Middle West. Although Wesleyan University again called him in 1895 and held him in a professorship until 1905, he thereupon returned to Wisconsin to spend there the remainder of his life. His retirement from active teaching came in 1929.

The development of American mathematics during the first quarter of the present century was phenomenal, and in this Professor Van Vleck played a prominent part. He become a member of the council of the American Mathematical Society in 1902, and was a "Colloquium Lecturer" before this society in 1903. He served the society from 1905–10 as an editor of its *Transactions*, in 1908 as its vice-president and during the years 1913–14 as its president. The mathematical literature over a period of many years is dotted with papers of his on infinite series; on functions defined by ordinary differential equations; on continued fractions; on point sets; on functional equations; on the roots of polynomials, etc. As a teacher he stood at all times for the highest standards of scholarly integrity. A considerable number of America's more accomplished contemporary mathematicians have at one time or another come under his influence.

Professor Van Vleck was the recipient of many honors. Aside from the offices through which the American Mathematical Society honored him, he was distinguished by Clark University (1909) and Wesleyan University (1925) as a doctor of laws; by the University of Groningen (1914) as a doctor of mathematics and physics; and by the University of Chicago (1916) as a doctor of science. The French government named him officier de l'instruction publique (1920); he became a member of the National Academy (1911); and he held the chairmanship of Section A of the American Association for the Advancement of Science (1912).

In his person Professor Van Vleck was modest and

kindly. His father had been distinguished before him as a professor of astronomy and mathematics and erstwhile president at Wesleyan University. He thus carried on a family tradition of intellectual interest and culture. He was a passionate and experienced traveler, and made his home the repository of many artistic treasures.

Professor Van Vleck is survived by Mrs. Van Vleck (Hester Raymond) whom he married in 1893, who shared with him his many interests and who continues to make her home in Madison, Wis., and by his son, John Hasbrouck Van Vleck, professor of mathematics and physics at Harvard University.

RUDOLPH E. LANGER

GEORGE WEST GRAVES

DR. GEORGE WEST GRAVES, professor of agriculture and biology at Fresno State College, died in Fresno, Calif., on October 26, 1943. Professor Graves was born in Cedar Rapids, Iowa, on May 1, 1886. He is survived by his wife, the former Ella Macklin, and his parents, Walter Robert Graves and Mary Alice Graves.

His early education was received in the public schools of Chicago, Ill., where he graduated from the John Marshall High School. In 1905 he was graduated from Oberlin College. He received the Ph.B. from the University of Chicago in 1908. In 1912 he was awarded the M.S. by the State College of Washington. Further graduate study at the University of Southern California, the University of California and the University of Chicago led to the Ph.D. from the University of Chicago, 1931.

His interests were broad and enhanced by visits to England, Scotland, France, Belgium, Holland, Germany, Switzerland, Austria and Italy. In connection with his travels he studied the development of gardens at Kew, Pous, Berlin, Dresden and Amsterdam.

During the first World War he served as instructor in field artillery at Camp Taylor.

His more serious research interests were in the field of botany, where he made contributions on the ecological relationships of *Pinus sabiniana*. At the time of his demise he was actively participating in a study of fertilization in *Araucaria Bidwillii*.

In addition to serving as supervisor of agriculture in the public schools of Los Angeles, Professor Graves served as instructor in the State College of Washington, the University of Southern California and the University of California.

From September, 1919, until his demise, he served continuously as head of the department of agriculture and biology at Fresno State College. During this period of service he was successful in developing the largest department in that institution.

He played an active role in improving agricultural and science education in the San Joaquin Valley during the past twenty years, and was greatly interested in the development of science education throughout California. Since 1932 he contributed generously to the planning and preparation of the "Science Guide for Elementary Schools," a progressive enterprise of the California State Department of Education.

For the past sixteen years, Dr. Graves assumed the chief responsibility for the development of experimental gardens at the Fresno State College. As a token of appreciation, the administration of the college has taken steps to designate this enterprise in his memory as the George West Graves Botanical Gardens.

His general understanding of college problems had a tremendous influence in the development of the Fresno State College. His warm, friendly thoughts were generously shared with both students and colleagues, who quickly learned to seek his counsel. Always dealing with principles, never indulging in personalities, he will be remembered by those who were privileged to know him as a splendid teacher, a warm counselor and a sincere friend.

LEO F. HADSALL

FRESNO STATE COLLEGE

RECENT DEATHS

DR. LOUIS J. RETTGER, of Bedford Village, N. Y., from 1891 to 1937 professor of physiology and dean of Indiana State Teachers College and from 1931 to 1935 vice-president, died on December 1 at the age of seventy-six years.

CHARLES W. MANN, since 1922 senior pomologist at the Bureau of Plant Industry of the U. S. Department of Agriculture, died on December 3 at the age of sixty-four years. Mr. Mann was soil scientist with the Bureau of Soils from 1906 to 1910, assistant pomologist of the Bureau of Plant Industry, 1910–1917 and pomologist from 1919–1922, when he was appointed senior pomologist. He was a fellow of the American Association for the Advancement of Science.

DR. WILLIAM SALANT, from 1908 to 1918 chief pharmacologist of the Bureau of Chemistry of the U. S. Department of Agriculture, died on December 10 at the age of seventy-three years. Dr. Salant became acting professor of physiological chemistry at the University of Wisconsin after leaving the Department of Agriculture, and from 1920 to 1929 was professor of physiology and pharmacology at the School of Medicine of the University of Georgia. He then became until his retirement in 1932 research pharmacologist of the biological laboratory at Cold Spring Harbor, L. I., N. Y.

DR. HAROLD STANARD ADAMS, vice-president and

plant manager of the Upjohn Company, manufacturing druggists, died on December 4 at the age of fifty-five years.

DR. QUICK LANDIS, research chemist at the Fleischmann Laboratories, Standard Brands, Incorporated, died on November 28 at the age of forty-two years.

SCIENTIFIC EVENTS

SCIENTIFIC AND TECHNOLOGICAL TRAINING IN GREAT BRITAIN

THE Parliamentary correspondent of *The Times*, London, reports that a motion, tabled in the House of Commons, by about one hundred members of Parliament of all parties urges the Government to take bold action to encourage scientific and technological training and to stimulate and coordinate research work of all kinds as an aid to post-war reconstruction policies. Most of the members who have signed the motion belong to the Parliamentary and Scientific Committee, of which the chairman is E. W. Salt, and many of them are members of the Tory Reform Committee. The sponsors of the motion are: Mr. Salt, Lord Hinchingbrooke, Dr. A. V. Hill, M. P. Price, Sir George Schuster and H. Graham White. The motion is as follows:

That this House, recognizing that if the United Kingdom is to maintain its position in the post-war world and carry out effective plans for physical reconstruction and social betterment, research and the application of scientific knowledge in all fields must be promoted on a far bolder scale than in the period 1919–39, urges his Majesty's Government forthwith:

(1) To assure the universities that in planning future developments for research, teaching, and higher learning as a whole they will receive support from the State on a much larger scale than hitherto.

(2) To arrange that education and training in schools, technical colleges, and universities shall be directed at the earliest date towards providing a far greater number of persons highly trained in science and technology.

(3) To set in motion schemes to ensure a substantial and coordinated expansion of research activity by private firms, cooperative industrial research associations, and State and other research establishments; and to this end, to provide assistance by adjustment of taxation, by more generous financial grants and through adequate priorities both in demobilization and for materials required for building and equipment.

RUBBER FROM RUSSIAN DANDELIONS

AN account of the work being done at Kew Gardens during the war was given on November 10 at the British Ministry of Agriculture by Sir Geoffrey Evans, economic botanist at Kew Gardens, who described, as reported in *The Times*, London, an experiment in the attempt to develop additional sources of rubber.

Seeds of three plants, from which rubber has of recent years been produced in Russia, were received at Kew and cultivated there and at 22 other stations. The plants were two kinds of dandelion—Kok-saghyz and Krim-saghyz—and a salsify, Tau-saghyz. The last was everywhere a failure, and Krim-saghyz proved rather delicate.

The most promising is Kok-saghyz, which comes from the Ukraine and Poland, and seems capable of giving as good results in Britain as in Russia—that is to say, a yield of perhaps 65 to 100 pounds of rubber to the acre, a figure which may be compared with 800 to 1,000 pounds an acre of Para rubber. These Russian dandelions contain from 2 per cent. to 17 per cent. of rubber in the dry root. No British native dandelion has been found to have more than 5 per cent. The rubber is found in the cells of the plant and can not be collected as with Para rubber from the latex or sap.

Kok-saghyz may be planted in the autumn and harvested the following August or it may be sown in the spring, and treated as an 18-month crop. The evidence is, however, that it needs good soil, and can not be grown on second-class land. Three or four crops sown in Scotland were poor.

The plant requires, moreover, a great deal of hand-weeding, which is extremely expensive. In Russia this is done by women and children on collective farms. The rubber is of reasonably good quality, but so far the authorities do not advise its general cultivation.

FINANCES OF THE UNIVERSITY OF ILLINOIS

ACCORDING to the annual financial report of Comptroller Lloyd Morey, in the seventy-five years since the University of Illinois began its educational and research activities, it has built and accumulated a plant and equipment worth $43,971,932. For the fiscal year, ending June 30, its income, including auxiliary enterprises, was $12,309,886, and the corresponding expenditures for all purposes were $11,893,878.

There are outstanding bonds in the amount of $2,233,800 on the Medical, Dental and Pharmacy Building in Chicago, and on four self-liquidating non-educational structures at Chicago and at Urbana.

The university has 2,383 acres of land, including the campus at Urbana-Champaign, the campus at Chicago, the agricultural experiment farms of 1,127 acres at Urbana-Champaign, and other farms comprising 700 acres in 24 counties; 74 major buildings and 70 others; utilities, equipment and a library containing 1,759,851 volumes, reprints, maps, etc., which make it the largest of any state university.

The portion of income used for educational and general purposes was $11,040,392, of which appropriations from state tax revenues provided $6,578,795

or 59.6 per cent. In the preceding year state taxes had provided $6,772,128 or 65.8 per cent.

The Federal Government supplied $2,356,149, while $1,258,710, or 11.4 per cent., came from student fees. Gifts from private sources amounted to $277,042, and sales of products and miscellaneous receipts to $569,696. Under war-time contracts with the Federal Government for special training and research work the university expended $1,294,701 in the fiscal year ending on June 30. Contracts provide reimbursement by the Government of that amount.

The largest single war project of last year was the engineering, science and management war-training program, administered by the university in fifty-four war plant communities of Illinois, and for the training of 17,000 plant executives and specialists. On this project $367,567 was disbursed.

Other major war projects include research, Naval training schools for signalmen, diesel engine operators and diesel officers, and an Army specialized training and reassignment unit. The Army specialized training program and Navy V-12 college training program began in the month following the closing date of the comptroller's report on June 30.

THE WORLD MAP OF THE NATIONAL GEOGRAPHIC MAGAZINE

THE need for a world map in one piece has been filled by the last of five wall maps that have been published this year by the National Geographic Society. "The World Map" is issued with the *National Geographic Magazine* for December.

The 10-color chart is a continuous, panoramic picture of the world with the United States in the center. Distances to fighting fronts and America's relative position to the rest of the world are easily seen. The "ends of the earth" consist of an arbitrary line drawn across Asia from the tip of India to the Arctic mouth of the Yenisei River, Siberia.

The map is drawn to Van der Grinten's projection, which reduces the polar distortions of Mercator's projection. In order to show the polar regions in true perspective, the chart includes two upper corner insets centered at the Poles.

The map of the Northern and Southern Hemispheres issued last April and the map of the Eastern and Western Hemispheres issued in December, 1941, complement each other in showing the world from varied points of view.

Features of the new map are the two bottom corner insets of world maps giving the line-ups of belligerents in World Wars I and II. In both insets the physical preponderance of the Allies over Germany and her satellites is readily seen. The boundaries shown are as of the first day of war—September 1, 1939.

Included in the map are clock faces indicating local time when it is midnight in Greenwich; arrows showing the direction of sea currents; distinctive colors for colonial empires; icy blue coloration for glaciers and ice-cap; and native spellings of place names as well as the English equivalents. A table of the geographical equivalents used on the face of the map appears at the bottom of the sheet.

THE DR. WILLIAM BEAUMONT FOUNDATION

AT the first meeting of the Dr. William Beaumont Memorial Foundation in Prairie du Chien, on September 18, according to a report in the *Journal* of the Association of American Colleges, Dr. William D. Stovall, Madison, director of the State Laboratory of Hygiene, was elected chairman of the board of directors, and M. J. Dyrud, Prairie du Chien, was chosen president.

The foundation was incorporated in May and its purpose is to "perpetuate the name and memory of Dr. Beaumont and his memorable experiments in the physiology of digestion, and to recognize noteworthy contributions made by other physicians and surgeons of the United States." Organization of the foundation was planned and carried through by the Crawford County Medical Society and the local Kiwanis club. The officers include Dr. Olaf E. Satter, *vice-president,* Dr. Thomas F. Farrell, *treasurer,* and J. Alvin Dru'yor, *secretary.* Other members of the board of directors are Mayor F. W. Clanton, F. A. Otto and Paul H. Schmidt, all of Prairie du Chien. Dr. Walter J. Meek, acting dean of the Medical School of the University of Wisconsin, has been appointed chairman of the advisory board by the directors. Other appointments made were Cal Peters, curator; Dr. Peter L. Scanlan, Dr. Henry H. Kleinpell, Dr. John J. Kane, Dr. Charles A. Armstrong and Dr. Emil H. Lechtenberg, medical advisers to the curator, and Mr. Dyrud, general manager.

The first meeting of the new foundation was held in the hospital section of the second Fort Crawford, built in 1829, in which Dr. Beaumont served as post surgeon under Colonel Zachary Taylor, then commandant at the fort.

THE AMERICAN PHARMACEUTICAL MANUFACTURERS' ASSOCIATION

EACH year the American Pharmaceutical Manufacturers' Association presents an award of distinction to a scientific man who has made a fundamental contribution to public health in the field of drug therapy.

The mid-year meeting of the association was held at the Waldorf-Astoria, New York City, on December 13 and 14, when the annual scientific award was made jointly *in absentia* to Dr. Alexander Fleming, professor of bacteriology at the University of London, for

his discovery of penicillin, and to Dr. Howard Walter Florey, professor of pathology at the University of Oxford, for his study of penicillin. The committee of award included Dr. George R. Cowgill, associate professor of physiological chemistry at the Medical School of Yale University, and Dr. Howard B. Lewis, professor of physiological chemistry and director of the College of Pharmacy of the University of Michigan.

Previous recipients of the medal are Dr. Nathan B. Eddy and Dr. Lyndon F. Small, for their studies of the chemistry, pharmacology and therapeutics of morphine derivatives; Dr. Perrin H. Long, for his study of the use of sulfanilamide, sulfapyridine and related pharmaceuticals in the treatment of disease; Dr. Tom D. Spies, for his contributions to our knowledge of the B-complex vitamins as pharmaceuticals important in the treatment of disease, and Dr. Edward A. Doisy, for his research in the hormone field.

The program on December 13, which was devoted to war medicine, included an introductory statement by Dr. Cowgill and addresses by Surgeon General Norman T. Kirk, U. S. Army, on "Army War Medicine"; by Acting Surgeon General Warren F. Draper, U. S. Public Health Service, on "Civilian War Medicine"; by Dr. Chester S. Keefer, professor of medicine at the School of Medicine of Boston University, on "The Research Physician in War Medicine"; by Dr. O. H. Perry Pepper, professor of medicine at the University of Pennsylvania School of Medicine, on "Medicine in War and After"; by Dr. Charles Thom, formerly principal mycologist of the U. S. Bureau of Plant Industry, on "Mold Research in War Medicine," and by Dr. George A. Harrop, director of the Squibb Institute for Medical Research, on "Pharmaceutical Development of War Medicine."

The program of the War Session on December 14 included addresses by Lieutenant Colonel Howard F. Currie, Commanding Officer, Army Medical Purchasing Office; Lieutenant Colonel Ralph R. Patch, chief of Production and Facilities Branch of the Procurement Division, Office of the Surgeon General, U. S. Army; Major E. P. Platt, chief of Contract Terminations and Surplus Property Section, Army Medical Purchasing Office; The Honorable Wendell Berge, Assistant U. S. Attorney General; Dr. Thomas A. McGoldrick, president of the New York State Medical Society; A. C. Nielsen, president of the A. C. Nielsen Company, and Charles Wesley Dunn, of the New York Bar.

SCIENTIFIC NOTES AND NEWS

THE Remington Medal of the American Pharmaceutical Association was presented on December 7 at a dinner given by the New York Branch at the Hotel McAlpin to Dr. Robert P. Fischelis, chief of the Chemicals, Drugs and Health Supplies Branch of the Office of Civilian Requirements and pharmaceutical chemist of Trenton, N. J. The award was made in recognition of "his outstanding contributions to the profession of pharmacy" and for his "literary, scientific and organizational activities over a period of years." Dr. Curt P. Wimmer, associate dean of the College of Pharmacy of Columbia University, made the presentation. Dr. Fischelis is president of the New Jersey Pharmaceutical Association and secretary of the Board of Pharmacy of the State of New Jersey.

THE American Mathematical Society at the recent annual meeting in Chicago awarded the Bocher Prize for the best original contribution to mathematical analysis published in an American mathematical periodical during the last five years to Dr. Jesse Douglas, assistant professor of mathematics at Brooklyn College. His articles were contributed to *The American Journal of Mathematics* in 1939 and to the *Transactions* of the American Mathematical Society in 1941.

A VOLUME on mathematics in honor of Professor J. Rey Pastor is being published by Rosario University, Argentina. Invited contributors from the United States are Professor George D. Birkhoff, Harvard University; Professor Edward Kasner, Columbia University, and Dr. John DeCicco, the Illinois Institute of Technology.

DR. SANFORD A. MOSS, of Lynn, Mass., known for his work on the development of the airplane turbosupercharger for the General Electric Company, has been awarded the Sylvanus Albert Reed prize for 1943 by the Institute of the Aeronautical Sciences "in recognition of his notable contribution to aeronautical engineering." The award will be presented at the honors night dinner of the institute in New York on January 24. The Sylvanus Albert Reed Award was endowed in 1933 through a bequest of $10,000 by the late Dr. S. A. Reed and is given annually for outstanding achievements in the aeronautical sciences. It was awarded in 1942 to Igor I. Sikorsky, of the Sikorsky Aircraft Division of the United Aircraft Corporation.

AT the Columbus meeting of entomologists Dr. Clarence E. Mickel, of the University of Minnesota, was elected president of the Entomological Society of America, and Professor E. O. Essig, of the University of California, was elected president of the American Association of Economic Entomologists.

HUBERT M. TURNER, associate professor of electrical engineering at Yale University, has been elected presi-

dent of the Institute of Radio Engineers. He will take office at the first meeting of the year, which will be held in New York City on January 5.

THE Society of the Sigma Xi, at its forty-fourth annual convention on December 4, in Chicago, elected Professor Ernest Carroll Faust, of the department of tropical medicine of the Medical School of Tulane University, a member of the executive committee. Dr. Lincoln T. Work, Metal and Thermit Corporation, Rahway, N. J., was elected a member of the committee on membership. Dean George B. Pegram, of Columbia University, was reelected treasurer, and Dr. George A. Baitsell, of Yale University, was reelected secretary. Dr. Harlow Shapley, director of Harvard College Observatory, continues as president of the society, since the term to which he was elected continues through next year.

WILLIAM D. ENNIS, Humphreys professor of the economics of engineering at the Stevens Institute of Technology, because of ill health will retire on March 1 with the title emeritus.

DR. L. EVERARD NAPIER, for twenty years professor of tropical medicine at the Calcutta School of Tropical Medicine, is visiting professor of tropical medicine at the School of Medicine of Tulane University. He has also been appointed consultant on tropical medicine to the Secretary of War.

DR. CHARLES WALTER CLARKE, executive director of the American Social Hygiene Association, New York, has been made clinical professor of public health practise at the Harvard Medical School.

DR. LOWELL T. COGGESHALL, professor of epidemiology at the University of Michigan, has been appointed professor and chairman of the newly organized department of tropical diseases at the School of Public Health of the university. Hitherto tropical diseases have been included in the department of epidemiology, of which Dr. Thomas Francis, Jr., is chairman.

DR. HAROLD C. WIGGERS, assistant professor of physiology at the School of Medicine of Western Reserve University, has been appointed associate professor of physiology at the College of Medicine of the University of Illinois.

DR. W. F. CASSIE has been appointed to the chair of civil engineering at King's College, University of Durham.

DR. WILLIAM BERNARD ROBINSON KING, Woodwardian professor-elect of geology of the University of Cambridge, has been elected to a professorial fellowship at Magdalene College.

GEORGE F. LEONARD, vice-president of Tobacco By-Products and Chemical Corporation, Louisville, Ky., has been elected *chairman* and Dr. Alfred Weed, vice-president of John Powell Company, New York, *secretary*, of the Agricultural Insecticide and Fungicide Industry Advisory Committee of the Office of Price Administration.

R. F. HAMMATT, assistant to the chief of the U. S. Forest Service, has been appointed deputy national coordinator of the Office of Civilian Defense Forest Fire Fighters Service.

COLONEL PAUL RUSSELL, of Washington, field director of the Rockefeller Foundation, has been appointed director of the first Allied overseas school for the study of malaria, which was opened on December 6 at the University of Algiers.

DR. M. G. VAN CAMPEN has been promoted to be assistant scientific director of the research laboratories of the Wm. S. Merrell Company of Cincinnati, and Dr. Harold Werner has been appointed chief of the pharmacological division. Dr. Keith Wheeler recently joined the company as an organic research chemist.

SIR GEORGE THOMSON, professor of physics at the Imperial College of Science, London, who received the Nobel Prize for physics in 1937, has been appointed scientific adviser to the British Air Ministry. He will be responsible for examining air operations from the scientific aspect, the methods, weapons and equipment employed, and for advising the Air Staff and other Air Ministry departments on these matters. On all questions affecting radio-communication and radiolocation he will work in consultation with Sir Robert Watson-Watt, scientific adviser on telecommunications.

THE Committee of the Privy Council for Agricultural Research has appointed Lord De La Warr to be chairman of the Agricultural Research Council in succession to the late Sir Thomas Middleton. The committee has also appointed Professor I. de Burgh Daly, F.R.S., to be a member of the council in the place of Sir Joseph Barcroft, F.R.S., whose term of office has expired.

A. B. WINTERBOTTOM has joined the staff of the British Non-Ferrous Metals Research Association as a senior investigator. Mr. Winterbottom was carrying out independent research at the University of Norway (Trondheim), when Norway was invaded. He was recently repatriated after having undergone a period of detention in Germany.

DR. WILLIAM C. BLACK, professor of pathology at the School of Medicine of the University of Colorado, is now in Central America, taking one of the courses in tropical medicine given under the auspices of the Association of American Medical Colleges.

DR. STUART MUDD, professor of bacteriology at the Medical School of the University of Pennsylvania, lectured on December 2 at a meeting of the Theobald Smith Society. The lecture was entitled "Clues Regarding the Structure and Organization of the Simplest Living Systems."

DR. OSCAR RIDDLE delivered on December 1 a lecture in the Four College Genetic Series at Mount Holyoke College. He spoke on "Some Cases of Regulation by the Pituitary Gland."

DR. C. C. LITTLE, director of the Roscoe B. Jackson Memorial Laboratory at Bar Harbor, delivered on November 16 the fifth annual Barnard Hospital Lecture. The lecture was entitled "Parental Influence on the Incidence of Cancer."

DR. WALLACE E. PRATT, director of the Standard Oil Company of New Jersey, spoke on December 6 on "Future Supplies of Crude Oil" at a luncheon meeting of the Kappa Chapter of the Society of Sigma Xi of Columbia University.

THE annual Nobel Prize dinner was held in New York City on December 10. The speakers included Professor Harold C. Urey, of Columbia University, who received the award for chemistry in 1932, and Professor Otto Meyerhoff, of the University of Pennsylvania, who received the award for physiology and medicine in 1922. Father Robert I. Gannon, president of Fordham University, presided, and Chancellor Harry Woodburn Chase, of New York University, was the chairman. More than half of the twenty-seven Nobel Prize laureates now in this country attended the dinner.

SPEAKERS at the second War Conference on December 10 of the National Association of Manufacturers included Dr. Frank B. Jewett, president of the National Academy of Sciences; Dr. E. R. Weidlein, director, Mellon Institute of Industrial Research, Pittsburgh; Dr. A. R. Olpin, director, the Ohio State University Research Foundation; Lewis W. Waters, vice-president, General Foods Corporation; William C. Anthony, president, Anthony Company, Inc., Streator, Ill., and Dr. Gustav Egloff, president, American Institute of Chemists, and director of research, Universal Oil Products Corporation.

THE two hundred and fifty-eighth meeting of the American Physical Society will be held at the California Institute of Technology, Pasadena, on December 27. There will be two sessions, starting at 9:30 A.M. and 1:30 P.M. The morning session will be held in Room 155, Arms Laboratory, and the afternoon session in the Norman Bridge Laboratory. Following six contributed papers at the morning session, two invited papers will be given by Professors Linus Pauling and F. Zwicky. The afternoon session will open with invited papers by Professor Alexander Goetz and Dr. Otto Beeck, and these will be followed by the remainder of the contributed papers.

THE Field Museum of Natural History passed out of existence as a name on December 7, and the new name, Chicago Natural History Museum, went into effect officially with the granting of an amended state charter by the secretary of state at Springfield, according to an announcement made by Orr Goodson, acting director of the museum. The decision to change the name was announced in September by Stanley Field, president of the museum for the past thirty-five years, on the occasion of the celebration of the fiftieth anniversary of the institution's founding by the late Marshall Field. At that time President Field said: "The museum has had three names: Columbian Museum of Chicago—Field Columbian Museum—and Field Museum of Natural History. Mr. Marshall Field, III, has discussed with me several times the matter of the name of the museum. He has felt that since the museum was created and maintained for the public and has become identified in the minds of the public as a Chicago institution, and since it is now playing a growing and important part in the educational activities of the city—it would be appropriate, and also in the best interests of the museum, if the name were changed to the Chicago Natural History Museum, thereby identifying its ownership more closely with the people of Chicago, to whom, of course, it has always belonged."

DISCUSSION

STATISTICAL TREATMENT OF PERCENTAGE COUNTS

MANY data in biology and agriculture are in the form of percentage counts. In entomology, especially, the percentage or proportion of a population affected by some condition is of importance, and in many other fields, data of this type occur. In such cases each individual of the population studied is recognized as either succeeding or failing in a given respect; it is dead or alive, parasitized or non-parasitized, male or female, etc. Where we have a number of individuals we can make a statement of the percentage in each class. The percentages, if determined repeatedly from the same population by random samples, fall in the "binomial distribution" of mathematicians. As a rule they must be determined from very moderate numbers. The question of how far we

can go in applying standard statistical methods to them is continually being asked.

Tests using the chi-square distribution or direct calculation of probabilities are described in standard statistical texts (Snedecor,[1] Goulden[2] and others). In one form or another they answer the question as to whether two or more percentages could have been derived from the same population, or one could have been derived from a specified population. In many cases, however, percentages are each based on replicated experiments, as is needed for broad conclusions; and these tests have some limitations in such material, since we often get into somewhat different populations in our replication.

The application to such problems of the computed standard error of a difference or of analysis of variance requires assumptions which are not entirely fulfilled in enumerative data. However, with adequate numbers, and percentages in the range between 10 and 90, there is usually little trouble. While percentage counts are not exactly normal in distribution, they approach normality, and the mean of several will come nearer than any single one. The total number of those succeeding and also of those failing in the replications of a treatment must reach from 20 to 30 before this condition begins to be realized.

Variance among percentage counts is somewhat dependent on the mean, the part due strictly to random sampling being defined as pq/n.[3] However, between 10 and 90 per cent. the form of the relation does not lead to serious error in analysis of variance. Where extreme percentages must be compared, Bliss[4] has given us a transformation eliminating the correlation; it is tabled by Snedecor (Table 16.9). Percentages are replaced by their tabled functions, which are used in analysis and in drawing conclusions. Extreme percentages tend to be more symmetrical in distribution after the transformation, hence the requirement of 20 or more failing and succeeding may be relaxed a little with the transformation. However, it will not make feasible analysis where percentages in some classes are nearly all 0 or 100. The use of the method seldom gives conclusions much different from those from the use of unmodified percentages.

To be freely used, the percentages should be based on equal or nearly equal numbers. If base numbers for each determination are over 30 and do not vary widely, weighting will not give enough gain to be worthwhile.

The error estimate must include in some way the variance between tests at different times, which is usually larger than the theoretical minimum value pq/n, owing mostly to real variations in proportion in successive groups. Calculation of variance or standard deviation among successive percentage determinations and of the standard errors of means or of the mean difference, will follow well-known lines.

With several methods to be compared, analysis of variance may be applied. The form of analysis will follow the design of the experiment. Where each method is tested on several groups, differing from the groups used with the others, only the variance between and within methods will be determined. Where all are tested side by side on the same groups, the determination of variances between groups, between methods and for their interaction is possible. The interaction variance will function as error, and greater precision will be secured than in the first case.

As an example of possible treatment we can cite a comparison of percentage mortality among five insect groups treated with three compounds. Each percentage was determined from 100 insects. Results were as given in Table 1.

TABLE 1

Group No.	Compounds		
	A	B	C
1	25	52	77
2	38	67	82
3	27	48	69
4	30	70	74
5	31	58	78
Mean	30.2	59.0	76.0

The range of percentages, the base numbers and the total number surviving and dying in each treatment fulfil the requirements mentioned for comparisons by standard methods.

Here we may calculate the standard error of the mean difference between two compounds, taking advantage of the pairing, or carry out an analysis of the variance among two or more classes. We may even calculate from the latter analysis a standard error of the difference between any two means, if we are very careful to assure ourselves that it is representative.

On the other hand, consider a set of percentages of fruits attacked, based on 100 fruits each, under two treatments. With treatment A, the percentages are 6, 3, 2 and 5; with B, 7, 8, 5 and 11. The set under A fails in two respects in meeting the suggested standards; the percentages run well below 10 per cent. and the total number affected does not reach 20. With B, the total is over 20, but the percentages are still largely below 10 per cent. With a set based on only 25 individuals per unit, and percentages of 12, 16, 20 and 12, the standards are not met; while percentages are above

[1] G. W. Snedecor, "Statistical Methods," third edition, 1940.

[2] C. H. Goulden, "Methods of Statistical Analysis," 1939.

[3] Snedecor, *l.c.*, Sec. 16.2.

[4] C. I. Bliss, *Ohio Jour. Sci.*, 38: 9–12, 1938.

10 per cent. the total number affected does not reach 20.

We may cite another hypothetical case, of four treatments with 3 replications each percentage based on 100 (Table 2).

TABLE 2
PERCENTAGE OF FRUITS ATTACKED

Replication	Treatment			
	A	B	C	D
1	6	2	1	4
2	59	55	46	60
3	66	48	36	54

This would fulfil in part the standards suggested, but the low values in one replication would make it seem desirable to employ Bliss's transformation. While the use of the transformation will not modify conclusions greatly, the results with the transformed data are somewhat more trustworthy, where very extreme percentages are mixed with intermediate ones.

In conclusion, it may be stated that the standard methods discussed have some limitations in application to enumeration data of the percentage count type. However, where percentages are based on adequate and similar numbers, where they are between 10 and 90 per cent, and where individuals succeeding and failing each total 20 or more in a treatment, these methods may be used. With more extreme percentages a transformation may be of help, and larger total numbers may be needed.

F. M. WADLEY

BUREAU OF ENTOMOLOGY AND
PLANT QUARANTINE,
U. S. DEPARTMENT OF AGRICULTURE

THE GERMINATION OF DORMANT LETTUCE SEED

IN improvement work with lettuce dormancy in freshly harvested seed often causes delays and loss of valuable seed. Workers have reported that light, high oxygen and high carbon dioxide concentrations aid in breaking dormancy. Thompson and Kosar[1] found that two ml of 0.5 per cent. thiourea in water markedly stimulated the germination of most of the lots of lettuce seed (*Lactuca sativa* L.) which they germinated on filter paper in 95-mm Petri dishes in darkness at 24° to 26° C.

In a preliminary attempt to germinate freshly harvested dormant seed of *L. serriola* L. two lots of seed were treated in thiourea as done by Thompson and Kosar,[1] and similar lots were handled in exactly the same manner except that they were kept in diffused light of about 150 foot candles. After 72 hours 98 per cent. of the seed in the light had germinated as compared with less than 1 per cent. of those in the dark.

In an attempt to evaluate the benefit derived from thiourea and from light three lots of strains of *L. sativa,* closely related to 456 and seven lots of *L. serriola* seed were treated with thiourea and with water both in darkness and in light. All seed had been harvested the previous day, but much of the *L. sativa* seed had been mature for a considerable time and had not been harvested because the plants were grown in a greenhouse and were protected from winds. The *L. serriola* seed were gathered in abandoned fields near Ithaca two days after a period of considerable wind that would have blown off seed that had matured before that time. Temperatures ranged between 21° and 28° C. Counts were made after 72 hours. Results are given in Table I.

TABLE I

Lot number	Thiourea		Water	
	Light	Darkness	Light	Darkness
Lactuca sativa				
1	100	96	10	16
2	100	76	0	4
3	100	96	4	6
Lactuca serriola				
1	96	4	6	0
2	94	44	4	0
3	78	10	16	0
4	64	0	2	0
5	56	0	4	0
6	72	0	8	0
7	72	20	10	0

As pointed out by Thompson and Kosar[1] thiourea markedly retards the growth of the seedlings. This retarding effect of thiourea can be largely eliminated without loss of stimulation of germination if the seed is treated with thiourea for 24 hours and then washed. This can be done conveniently by transferring the filter paper with the wet seed clinging to it to a Büchner funnel, washing well with distilled water and returning it to the rinsed Petri dish. Six lots of freshly harvested *L. serriola* seed treated in that manner varied in germination from 100 per cent. to 88 per cent. with an average of 94 per cent., while but one seed of the 300 of the 6 comparable lots moistened with water and left in the dark germinated.

In using this method for the growing of plants the treatment is started in the late afternoon so that the seed may have a maximum period of light following the night period when absorption of the thiourea solution may take place. Late the following afternoon the seed is washed with distilled water and returned to the Petri dish for planting the next morning in sand wet with dilute nutrient solution.

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[1] Ross C. Thompson and William F. Kosar, *Plant Physiology*, 14: 567–573, 1939.

SOME MISLEADING TERMINOLOGIES IN THE LITERATURE OF "PLANT TISSUE CULTURE"

MOST of the so-called tissues of the higher plants contain varying proportions of cells whose protoplasts are capable of division and subsequent growth. Under traumatic and other excessively abnormal influences, such protoplasts frequently proliferate and form callus, *e.g.*, in wound healing, in grafting, etc. Callus-like proliferations derived from excised parts of plants, when grown under controlled conditions *in vitro*, obviously provide extremely significant material for the experimental investigation of various morphological and physiological problems. It is misleading, however, to refer to such proliferations as cultures of a specific tissue even when the exact source of the callus is accurately known.

In the case of putative cultures of the cambium, not only is the callus entirely unlike the cambium in its cellular structure and its functional activities, but also there is no convincing evidence to indicate that the proliferations originated from the cambium.

The cambium consists of a layer of initials having a radial diameter of from 4 to 8 microns. It is flanked internally by elements of the xylem in varying stages of maturation and externally by elements of the phloem in varying stages of development. The parenchyma of the xylem and phloem commonly retains a capacity for cell division, as do tracheary elements, fibers and sieve cells during the earlier stages of their maturation. Even by using a microtome, it is unfortunately impossible to cut a tangential longitudinal section of a stem or root that consists entirely of living cambial initials. In the techniques employed by Gautheret,[1] White[2] and others, the bulk of the excised tissue, from which proliferations develop, consists of maturing xylem and phloem. In other words, there is no evidence to indicate that the callus originates solely from the cambium, rather than entirely or in part from its derivative tissues. Furthermore, the assumption that the bark of growing plants tends to split away from the wood along the cambium is entirely without justification. During the active growing season, the zone of excessive weakness lies well within the maturing xylem, *viz.*, in the region where tracheary elements have attained their maximum size, but haven't initiated the process of secondary wall formation. Thus, the cellular proliferations obtained on tangential surfaces that are exposed by pealing, splitting, tearing or cutting commonly do not originate from the cambium.

Until methods are perfected for actually isolating parts of meristems and for inducing them to grow without profoundly modifying their constituent cells, it is inadvisable to refer to abnormal proliferations obtained from heterogeneous bits of stems, roots or other organs as cultures of the cambium, procambium, cork cambium, etc.

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[1] R. J. Gautheret, *Rev. Cytol. et Cytophysiol. Vég.*, Paris, 1935.

[2] P. R. White, A Handbook of Plant Tissue Culture. Jaques Cattell Press. 1943.

RELATIVE VALUES FOR DESCRIPTIVE WORDS

THE interest in the uniform usage of words of indefinite meaning is probably not new. It is encouraging to note that recently several SCIENCE readers want to do something about it. One more suggestion may contribute to this interest and to a solution of the problem.

A numerical word has a definite value and wherever the figure appears it has the same value. For example, the figure 75 per cent. has an actual value and also indicates a value midway between half and total. But one statement that "oaks are common" has very little value when compared to another similar statement unless the value of the word "common" is rather definitely established. An observer may report that "the disease is prevalent in Brown County and common in White County." Without knowing the relative values of the words "prevalent" and "common," the reader can not learn from the report whether the disease is more, the same or less in Brown County compared to White County. To correct this situation, the relative values of such terms as "common" and "prevalent" should be established and used in such reports. With a standardized relative value, a word which ordinarily has an indefinite value may be used to convey a meaning about as definite as the condition on which the word is based.

It is proposed that a table of relative values be established for the use of a particular profession or a group of professions such as plant pathology, entomology, etc. A procedure similar to that employed in standardizing common names of trees or insects by a consensus of opinions might be used for this job. Of course, all individual opinions should yield to a consensus of opinions, and all reporters should adhere to the established relative values.

The relative values of a set of words could be based on an average or mean point and vary from that point to a maximum or minimum. For example, for such words as "abundant," "common" and "trace," indicating frequency of occurrence, the term "common" might be taken as the average or mean occurrence, "abundant" as the maximum frequency, and "trace" as the minimum amount. With this as a starting point such terms as "scarce," "light," "frequent," "prevalent," etc., could be given similar or in-between relative values. The same procedure could be used for

words describing the health of a plant, so that such terms as "vigorous," "thrifty," "normal," "suppressed," etc., would have known relative values.

Table 1 is presented as an illustration of how relative terms on these subjects may be arranged. There is no contention that all the terms in the table are somewhat similar conditions. Furthermore, it would be known that the terms "sickly," "low vitality," "failing" and "weak" indicate a condition less favorable than that indicated by the above terms.

The writer will appreciate various opinions on this plan as well as suggestions on how it might be worked out. He is especially interested in learning how other writers would place the words used in the table. Examples of how descriptive words on other subjects might be arranged will be appreciated. If sufficient opinions are offered, the possibilities of arriving at a fair consensus of opinions may be indicated.

TABLE 1

Abundant	Frequent many	Prevalent	Common normal average	Light scattered	Scarce few	Trace rare
luxuriant abundant	vigorous robust	strong thrifty good condition	normal healthy ordinary	declining suppressed impaired poor condition	sickly low vitality failing weak	dying deteriorating

appropriate to the subject or are properly placed. Such definite selection and placement must be based on a consensus of opinions.

If such relative values were established and used by all reporters on plant growth, for example, the readers would know that the terms "declining," "suppressed," "impaired" and "poor condition" indicate

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SCIENTIFIC BOOKS

NUTRITION

The Science of Nutrition. By HENRY C. SHERMAN. xi + 253 pp. Columbia University Press. 1943. $2.75.

THIS book, written by a master in the field, is quite unique in its content. Not only does it attempt to present in a non-technical manner the general principles of nutrition, but the second half of the book is largely concerned with such chapters as "Are We Well Fed?," "The Nutritional Improvement of Life," "Nutrition for Realization of the Potentialities of Youth and of Maturity," "Nutritional Guidance for 'The Backward Art of Spending Money'" and "Nutrition Policy." It is concluded with a chapter dealing with "Scientific Critique of the 'Offer' of Higher Health and Longer Life." It is suggested in the preface that certain of the chapters which are heavy reading may be omitted without loss of understanding of the balance of the book; this may account for some amount of repetition.

The choice of title is unfortunate, for it is likely to be confused with the comprehensive text of the late Professor Graham Lusk of the same title. The treatise is logically written and well outlined; its manner of presentation should make it equally interesting to the trained nutritionist as well as to the uninitiated layman. The style and content are not sufficiently simple, however, to appeal to the uneducated man.

In discussing "Food as a fuel and body as a machine" (Chapter II), the author postulates that the excess of calories measured by direct calorimetry (0.25 per cent.) over those calculated by indirect calorimetry may be accounted for from the energy derived from light in causing an impulse in the optic nerve or resulting from the activation of vitamin D. However, from the reviewer's experience in this field, it would seem that the differences compiled by Armsby for experiments with dogs and herbivora (1,445,398 calories by direct; 1,441,691 calories by indirect) can best be explained as in the range of experimental error. As a criterion for overweight, Sherman cites the interesting case of Joe Louis, who, when in condition, would have been judged by ordinary standards too heavy for the Army or Navy. Specific gravity rather than absolute weight is a better measure and

> So by weighing him in water as well as in air, it was duly determined that Mr. Joe Louis was physically fit for service in the armed forces of the United States.

The historical discussion of the vitamins is especially well done. The author suggests that the layman should recognize "vitamine" as well as the present accepted spelling without the "e" and then proceeds to be inconsistent by spelling it both ways in later pages.

There is an interesting anecdote of the country doctor in the Virginia of the nineties who ordinarily made his rounds on horseback and who, like most people, was more or less troubled with rheumatism in the winter and spring. He ignored this until his joints became so sore that they troubled him in getting on his horse; "then he sucked lemons until the soreness of his joints went away." Later the author cites the work of Crandon and coworkers at the Har-

vard Medical School, where it was shown that a young adult may endure complete deprivation of vitamin C for long periods; it required two months before the ascorbic acid of the blood was reduced to zero, 134 days until clinical signs of scurvy were apparent, and more than five months (161 days) before distinct petechiae with retarded healing of an experimental wound were found. In the light of this information the recommendation on page 56 that,

> because of its labile nature . . ., we now believe it a good investment to include some significant source of this vitamin (C) in every meal, and to provide fruit or fruit juice instead of sweets if snacks are to be eaten between meals or before bedtime,

would seem to be very inconsistent and easily misunderstood by the laity.

One gets the impression that fortified oleomargarine is to be considered as an inferior fat to butter since the amount of vitamin A added approaches what may be considered "their share," which is "perhaps half as much as in good butter." The author neglects to explain that the level of 9,000 I.U. of vitamin A declared on the labels of various fortified margarines was set on the basis that this was the average vitamin A content of butters (good and poor). Unfortunately, the buyer has no way of knowing whether he is purchasing superior butter with 18,000 I.U. per pound or poor butter with 2,500 I.U. per pound.

In Chapter VIII on "How the Body Manages its Nutritional Resources" it is considered that one should not speak of bodily processes as mechanisms. Such *"isms"* are likely to become *"wasms,"* as W. M. Clarke earlier suggested was rapidly occurring with some scientific theories.

In Chapter IX on "The Nutritional Characteristics of the Chief Groups of Foods" the author has an interesting historical discussion on the milling of flour and emphasizes the importance of breadstuffs (especially from enriched flour) in our diets whereby as much as 38 per cent. of the calories, 37 per cent. of the protein and 30 per cent. of the phosphorus may be obtained by the expenditure of only 18 per cent. of the average budget for foods.

On the one hand, we are advised that nutritional deficiencies are much higher than is apparent from actuarial statistics due to non-recognition or mislabeling of the cause of death. "Our greatest nutritional handicap in the United States," it is stated, "is not that part of the population which is starving in the historic sense, nor that part which is *recognized* as suffering from specific nutritional deficiency diseases, but the part (probably much larger than those other parts put together) which 'is getting along on poor diets.'" On the other hand, we are later advised that the 1943 freshman class at Yale, although the youngest on record, is the tallest class in the history of that institution.

The last chapter is concerned largely with experimental evidence of the effect of diet on the rate of growth, on reproduction and on longevity. The author's experiments in this field are described in an interesting manner at some length. There is a selected bibliography of approximately 250 titles at the end.

When one has completed the book, there is a feeling that the information gained carries considerable authority.

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AERIAL PHOTOGRAPHS

Aerial Photographs: Their Use and Interpretation. By A. J. EARDLEY. New York and London: Harper and Brothers. 203 + xxiv pp. Fully illustrated. $2.75.

THE aerial photograph is one of the most important implements of the war. It facilitates the construction of new maps and the revision of old ones. It provides the surest means of finding out about the enemy's defenses, the details of his communication systems, his industrial plants, his harbor installations and air fields, his troop, armor, matériel and ship movements. It provides the aerial bombardier with details of his targets and permits him to assess the damage caused by his bombing raids. In addition, the aerial photograph is an important implement of peace. Combined with some control from the ground, aerial photography permits the accurate survey of terrain which may range from a small parcel of real estate to large expanses of territory difficult of access on the ground. Its economic importance is already recognized and will grow rapidly. Vast studies have already been made of silting and soil erosion, of crop distribution and farm acreage, of timber growths, of geological features. Aerial photographs are used in surveys for laying oil pipe lines and power transmission lines, in water control and in many other important fields. In the days of untrammelled automobile traffic, they were even used for studying parking problems.

At the present time many people, both in the services and out, are learning to make or to interpret aerial photographs. A limited number of good texts are available to them for study. The present volume is a very good simple introduction to the subject in general, and an excellent treatise on the special study of geology by aerial photography. It has withstood the test of the classroom and laboratory.

The first third of the book treats of the taking of aerial photographs and their characteristics; there is a good introduction to the use of the stereoscope and plotting contours; and an introduction to making mosaics, including the radial line method of plotting.

The remainder of the book is concerned with the applications to geology, and a final chapter treats of tactical interpretation. It is a pioneering work in the geological field, and it is assumed that the student has had introductory courses in geology and elementary mineralogy and lithology. It should not be assumed, however, that it is only of use to the geologist, for geological structure determines other surface characteristics, and interpretation of the geological features shown in aerial photographs may be of much value for use in other fields. The strict geological interpretation is based on a thorough background of field geology, but a simple knowledge of geological characteristics is of help for general interpretation.

The man versed in the science of photogrammetry will find much lacking in the book. But it is not for him, and the selection of elementary material has been judiciously made and results in a good introduction to the interpretation of aerial photographs. It is to be expected that with the rapid changes going on in aerial photography, some sections, such as that dealing with apparatus, are somewhat out of date, but little is lost as a result. Not enough study has yet been made of infrared and color photography from the air to be able to state definitely that they are of importance, but one feels that some mention of the work already done in these fields should have been made. They show much promise. As in most books on this subject, one of the most important and fundamental aspects is but slightly touched, that is, the characteristics of photographic films and processing desirable for the production of negatives suitable for aerial photographic interpretation. It is far too easy to make a bad photograph—or, rather, we should perhaps say it requires much knowledge and experience to produce the best kind of photograph. Far too few people have that knowledge. It is to be hoped that the next edition of the book under review, which is otherwise very good, will include an authoritative chapter on the desirable photographic materials and their characteristics.

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SPECIAL ARTICLES

THE ANTIGENICITY OF PROTEIN ISOLATED FROM BOVINE SERUM AFTER BRIEF TREATMENT WITH ALKALI[1]

IN a recent publication, Lewis[2] states that "beef plasma which had been incubated one hour or longer with 0.5 normal sodium hydroxide and then neutralized was no longer antigenic when tested by gross anaphylaxis or by the more sensitive method using uterine strips from guinea pigs sensitized to native beef plasma." If we interpret this statement correctly, tests for antigenicity were carried out by using native plasma as the sensitizing antigen and alkali-treated protein as the shocking material. Apparently these results were interpreted to indicate a complete loss of antigenicity after treatment of the plasma with alkali. Obviously, however, it can not be decided from these data whether the results obtained were due to a change in antigenic specificity or to a loss of antigenicity. It has been our experience that protein isolated from bovine serum after exposure to 1 N alkali at room temperature for periods as long as 8 hours is still antigenic, although its antigenic specificity usually is altered by the alkaline treatment. Some of the data in support of our conclusions are included in this paper. A more detailed report will be published elsewhere at a later date.

The antigenicity of alkali-treated egg albumin,[3,4,5] horse serum,[6,7,8] zein,[5] edestin,[5] casein[5], and beef serum[8,9] has been studied by several investigators. In general, these studies have indicated that prolonged treatment with alkali will abolish antigenicity. However, Landsteiner and Barron[6] found that the protein isolated from horse serum treated with 1 N sodium hydroxide for 16 hours still gave weak complement fixation and precipitin reactions with homologous antiserum. Johnson and Wormall[7] reported similar results; treatment of horse serum at pH 13 or above for about 24 hours was required to abolish antigenicity.

Studies in these laboratories have indicated that the protein isolated from bovine serum treated with 1 N sodium hydroxide for 27 hours at room temperature apparently is non-antigenic.[9] The tests that have been employed for antigenicity include active anaphylaxis, passive anaphylaxis, complement fixation, and precipitin reactions. However, this material is not suitable for use in human therapy, since it is fatal to guinea pigs when given intravenously in doses of 35 mg per kg or larger. Lewis[2] stated that products prepared

[1] From the Departments of Immunochemistry and Biochemistry, Medical-Research Division, Sharp and Dohme, Inc., Glenolden, Pa.

[2] J. H. Lewis, SCIENCE, 98: 371, 1943.

[3] H. G. Wells, *Jour. Inf. Diseases*, 6: 506, 1909.

[4] C. Ten Broeck, *Jour. Biol. Chem.*, 17: 369, 1914.

[5] R. L. Kahn and A. McNeil, *Jour. Immunol.*, 3: 277, 1918.

[6] K. Landsteiner and C. Barron, *Zeits. Immunität.*, 26: 142, 1917.

[7] L. R. Johnson and A. Wormall, *Biochem. Jour.*, 26: 1202, 1932.

[8] H. A. Davis and A. G. Eaton, *Proc. Soc. Exp. Biol. Med.*, 50: 246, 1942.

[9] L. E. Arnow, L. A. Kazal and R. J. DeFalco, *Jour. Biol. Chem.*, 145: 347, 1942.

y treating bovine plasma with 0.5 N sodium hydroxide at 37° C. for periods longer than 8 hours were oxic when injected into guinea pigs, although such products were non-antigenic by the criteria employed.

We have tested also preparations isolated after reatment of bovine serum with 1 N sodium hydroxide t room temperature for periods of 1 hour, 2 hours, hours and 8 hours. None of these preparations ppeared to be toxic when administered intravenously o guinea pigs in doses as large as 300 mg per kg. he materials isolated after 1 hour and 2 hours (but ot those isolated after 4 hours and 8 hours) gave eak precipitin tests with an antiserum prepared by njecting untreated bovine serum into rabbits. These me materials gave negative tests with other potent ntisera prepared in the same way. However, we ave been successful in preparing antisera to each of hese 4 materials by intermittent intravenous injection into rabbits for periods of from 21 to 99 days. t is interesting that untreated bovine serum and all 4 f the alkali-treated materials gave positive precipitin ests with each of the antisera prepared with the lkali-treated proteins. Guinea pigs passively sensitized with antiserum prepared with protein isolated fter treatment of serum for 2 hours with alkali were hocked with each of the other alkali-treated preparations (except the preparation treated for 1 hour, which was not tested) and with untreated bovine erum.

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A PHYSICAL DEFICIENCY IN THE RATION OF RUMINANTS

THAT ruminants do not thrive on a ration limited to concentrates is well known. Several investigators have attempted to determine the deficiencies associated with such a diet.[1,2,3,4,5,6] Mead and his coworkers[4,5,6] found that calves could be carried through growth, pregnancy and lactation if cod-liver oil and calcium carbonate were added to a common concentrate mix. These animals could not, however, be considered normal, for it was necessary to limit their food consumption to avoid bloat. Despite precautions, four of the animals died of this cause. Johnson and his associates[7] fed calves a purified diet, adding Cellophane to make the ration more bulky. They state: "The growth rates of the 15 calves studied were below normal in most cases in comparison with Ragsdale's Standards. Poor food consumption associated with periodic digestive upsets seemed to be largely responsible for the slow growth."

As we have duplicated several of the symptoms observed on a diet of concentrates simply by fine grinding of roughage, it appears that a concentrate diet has physical as well as chemical or nutritive deficiencies. Several workers have considered that the mere lack of bulk might be a limiting factor in a concentrate diet for ruminants. The addition of soft bulky material such as paper pulp[6] or Cellophane[7] had, however, little beneficial effect. Rather, the limiting physical factor in a concentrate diet appears to be the absence of the coarse sharp material necessary to stimulate nerve fibers terminating in the ruminal mucosa. In experiments with cattle and sheep, finely ground alfalfa hay was compared with whole alfalfa, each being given in conjunction with concentrates. The concentrates and hay were fed in approximately equal proportions. The concentrate mixture consisted of rolled barley 60 per cent.; wheat bran 25 per cent.; soybean meal 12.5 per cent.; NaCl 2.5 per cent. The animals received all they would consume over a feeding period of approximately 8 hours. Since the chemical constituents of the two rations were the same, any discrepancies in response should depend upon the physical condition of the feed—whether ground or whole.

The following disorders were noted only when finely ground alfalfa was fed:

(1) Rumination occurred very irregularly or not at all. This is in line with the finding of Schalk and Amadon[8] that coarse material in the rumen stimulates rumination. Fine grinding so effectively breaks down the alfalfa stems that their irritating effect is largely lost.

(2) Bloat occurred frequently in cattle, but only once in a sheep. Twenty-one cases of bloat were encountered in 4 cows receiving the ground alfalfa hay over a 15-day period. This finding supports the postulate[9] that bloat results from a lack of sufficient coarse irritating roughage to induce the eructation reflex.

(3) Food consumption in cows was reduced as compared with consumption of whole alfalfa. This reduction amounted to 6.9 pounds daily per animal. The reduced consumption by cows receiving finely ground hay was largely due to the fact that, after consuming a large amount on one day, they were off-feed

[1] E. Davenport, *Ill. Agr. Exp. Sta. Bul.*, 46, 1897.
[2] A. C. McCandlish, *Jour. Dairy Sci.*, 6: 54, 1923.
[3] C. F. Huffman, *Mich. Exp. Sta. Quart. Bul.*, 11, No. 1, 1928.
[4] S. W. Mead and W. M. Regan, *Jour. Dairy Sci.*, 14: 283, 1931.
[5] S. W. Mead and H. Goss, *Jour. Dairy Sci.*, 18: 162, 1935.
[6] S. W. Mead and H. Goss, *Jour. Dairy Sci.*, 19: 465 (Abstract), 1936.
[7] P. E. Johnson, J. K. Loosli and L. A. Maynard, *Jour. Dairy Sci.*, 23: 553 (Abstract), 1940.
[8] A. F. Schalk and R. S. Amadon, *N. Dak. Agr. Exp. Sta. Bul.*, 216, 1928.
[9] H. H. Cole, S. W. Mead and M. Kleiber, *Calif. Agr. Exp. Sta. Bul.* 662, 1942.

the next. This experience agrees with that reported by Johnson and his co-workers for calves on purified diets. As Mead and Goss[6] limited food consumption to avoid bloat, they had no critical measure of the appetites of their animals. In ewes this difference in food consumption was not manifest.

(4) The animals had depraved appetites, manifested by wood chewing. This condition was observed in both ruminants and was not evident when finely ground alfalfa was replaced by whole alfalfa. Although others[2, 10] have observed this phenomenon when ruminants were limited to concentrates, it has not been attributed previously to the physical nature of the diet. Since the animals were fed all they would consume, hunger in the usual sense of the term was not involved.

The lack of coarse material in the diet appeared to produce more pronounced symptoms in cattle than in sheep. Possibly, then, the former require coarser feeds. As is well known, cattle consume coarse, stemmy roughages more readily.

These results show that a physical deficiency, a lack of coarse irritating material in the rumen, in the ration of ruminants results in the following syndrome: failure of, or diminished, rumination; difficulty in eructation, often causing tympany or bloat, especially in cattle; reduction in food consumption in cattle; and depraved appetite, as manifested by wood chewing.

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THE CULTURE OF YOUNG CONIFER EMBRYOS IN VITRO

CULTURE of embryos *in vitro* has been made by many workers in the past, the more important works on the subject are those of Dietrich,[1] Li,[2] LaRue,[3] Tukey,[4] Bonner,[5] Solacolu, *et al.*[6] and van Overbeek, *et al.*[7] The materials used by these workers are mature or immature plant embryos which had already attained considerable size. As far as we are aware, no successful attempt has been made to culture very young embryos of one to several cells in size. The present account is a preliminary report of our work, which is being continued, on the culture of isolated conifer embryos when the latter are only at the one- or several-cell stage.

Embryos of pine (*Pinus yunnanensis*) and Keteleeria (*K. Davidiana*) were dissected out from the ovules and transferred to culture media in Petri dishes under asceptic conditions. The medium used is a modified Pfeffer's solution[8] containing 2 per cent. sucrose and 0.6 per cent. agar. To this "standard" medium (SM) was added various growth substances (heteroauxin, 10 mg per liter; thiamin, 0.1 mg per liter; ascorbic acid, 10 mg. per liter; nicotinic acid, 1 mg per liter or vitamin B_6, 0.1 mg per liter).

Young embryos[9] of pine were inoculated on agar media containing SM and SM and added growth substances on June 11, 1942. After two weeks, the one- to several-celled embryos grown on SM had less than ten cells, while that grown on SM plus indol-acetic acid developed into an embryo of several hundred cells in size, and that grown on SM plus thiamin attained a size of about one hundred cells. Later observations, made on and after July 29, revealed but little growth in any of the cultures.

Keteleeria embryos were cultured in the same manner on July 7. In one of the cultures containing SM plus indol-acetic acid and thiamin a 2-celled embryo of $60 \times 40\ \mu$ became a 12-celled embryo of $156 \times 117\ \mu$ ten days later, and this developed into a multicelled embryo of $608 \times 156\ \mu$ on July 25. Although young embryos of Keteleeria can develop somewhat on all the media used, none of these can approach SM with indol-acetic acid and thiamin as a favorable medium for the growth and development of Keteleeria embryos.

Further work on this problem is necessarily postponed due to seasonal limitations, but these preliminary experiments indicate that it is probable that conifer embryos of one to several cells in size can grow and develop normally *in vitro* in the presence of heteroauxin and thiamin, at least for a certain length of time. It is possible that they may even be grown to maturity *in vitro* with medium containing other growth factors in addition to heteroauxin and thiamin.

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[10] L. L. Madsen, C. M. McKay and L. A. Maynard, *Cornell Univ. Agr. Exp. Sta. Mem.* 178, 1935.

[1] K. Dietrich, *Flora N. F.*, 17: 379, 1924.

[2] T. T. Li, *Sci. Rept. Nat. Tsing Hua Univ.*, Ser. B. 2: 29, 1934.

[3] C. D. LaRue, *Am. Jour. Bot.*, 22: 914, 1935; *Bull. Torrey Bot. Club*, 63: 365, 1936, and 65: 11, 1938.

[4] H. B. Tukey, *Jour. Hered.*, 24: 1, 1933; *Am. Soc. Hort. Sci.*, 32: 313, 1934; *Bot. Gaz.*, 99: 630, 1938.

[5] J. Bonner, *Plant Physiol.*, 13: 865, 1938; *Proc. Nat. Acad. Sci.*, 24: 70, 1938.

[6] T. Solacolu, *et al.*, *Compt. Rend. Soc. Biol.*, 129: 403, 1938.

[7] J. van Overbeek, *et al.*, SCIENCE, 94: 2441, 350, 1941.

[8] One liter of this solution contains: $Ca(NO_3)_2$, 328 mg; KNO_3, 80 mg; $MgSO_4 \cdot 7\,H_2O$, 98 mg; KH_2SO_4, 13 mg; KCl, 74 mg; $FeCl_3$, 1.6 mg.

[9] Young embryos of pine undergo cleavage soon after the elongation of their suspensors, so that each embryo is split into four single-celled embryos.

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SCIENTIFIC APPARATUS AND LABORATORY METHODS

EMATOCRIT DETERMINATION OF RELATIVE CELL VOLUME[1]

THE determination of the volume of erythrocytes d similar free cells relative to their suspending fluid y be carried out rapidly and with high preion. A number of types of hematocrit tubes have en described, all of which are adapted to low centfugal forces. Adequate packing of red cells with

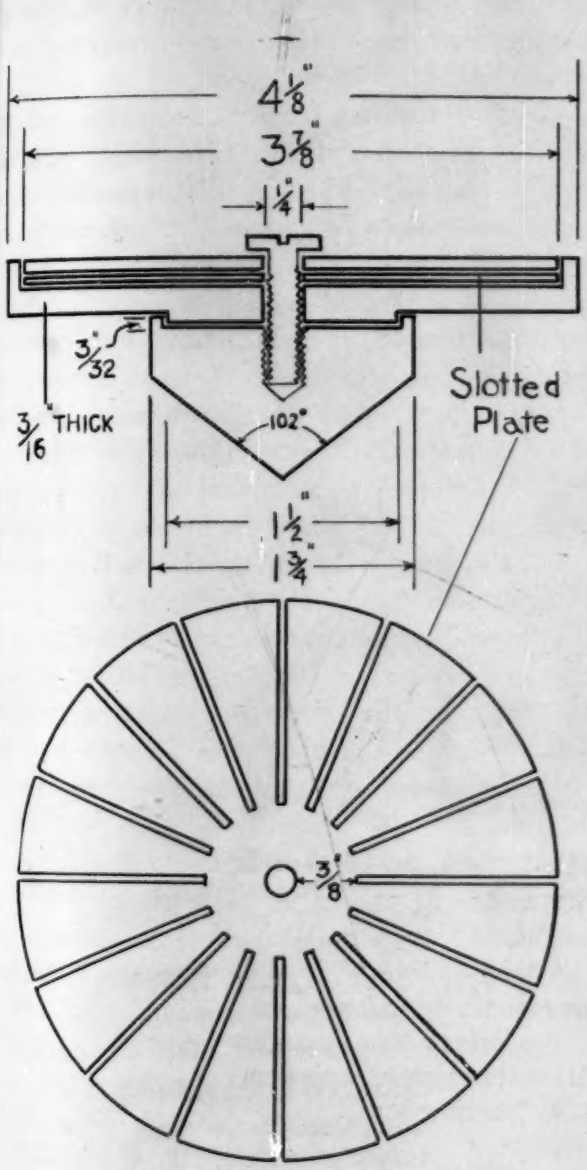

FIG. 1

complete expression of the supernatant fluid requires high forces. We have found thin-walled, capillary tubing (o.d. 0.5 mm, i.d. 0.35 mm) used in conjunction with an air turbine of the type used by Beams[2] a most satisfactory answer to this problem. The capillary tubing must have a uniform bore.

In detail the method involves allowing well-mixed blood to be drawn by capillarity into capillary tubes 3 cms in length to within 0.5 cms from one end. This latter end is quickly sealed in a small oxygen-gas flame, care being taken not to heat the blood. After brief practice at such sealing it is possible to seal the tube so that the internal bottom of the tube is approximately flat.

These filled, sealed tubes are put into the slots of the flat disc rotor shown in Fig. 1, and centrifuged for five minutes at a force of ca. 30,000 × G. This force and time of centrifuging was found to give practically complete packing of the red cells in freshly collected blood with a standard deviation of the red cell total volume of 0.34 per cent. This fact is based on experimental studies which have shown that at all forces between 20,000 and 190,000 × G, the degree of packing of red cells is approaching an asymptotic value which is 1.7 per cent. less than the packing obtained at the lower force. Between 40,000 × G and 190,000 × G the red cell volume drops only 0.7 per cent.

Studies on blood with varying degrees of hemolysis have shown that the relative volume of the intact cells can be determined by this method with a standard deviation of 0.84 per cent. This value does not include 3 deviations which were 3.7 σ, 5.9 σ and 6.2 σ; and is based on 106 determinations. The degree of hemolysis varied from 1 to 43 per cent.

Red cells which have been packed by this method can be resuspended and repacked three times without showing any change in the length of the cell column. This indicates that packing at high forces does not cause any rupture of the cells.

Readings on the length of the cell column and of the total column are made under a dissecting microscope against a standard steel rule engraved in 0.5 mm divisions. At the higher centrifugal forces short (1 cm) tubes are used. Their cell and total column length are measured under the microscope with a Filar Ocular Micrometer. Such readings can be reproduced with a standard deviation of 0.14 per cent. If longer times of centrifuging are required then these tubes must be sealed at both ends to check evaporation. Care must be taken to place the hematocrit tubes in the vertical position as soon after centrifuging as possible.

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[1] The work described in this paper was done under a contract, recommended by the Committee on Medical Research, between the Office of Scientific Research and Development and Princeton University.

[2] J. W. Beams, SCIENCE, 74: 44, 1931.

SIMPLE ADAPTERS FOR CONTINUOUS EXTRACTION OF AQUEOUS SOLUTIONS IN THE SOXHLET EXTRACTOR

THE problem of the continuous extraction of aqueous solutions by immiscible solvents is one that presents itself quite frequently. While many devices have been described for just this purpose, the construction of most, if not all, requires an expert glass-blower. Most laboratories are equipped with, or can readily obtain, a Soxhlet-type extractor. The present communication describes two simple adapters which have been found extremely useful in this laboratory which extend the versatility of the Soxhlet extractor

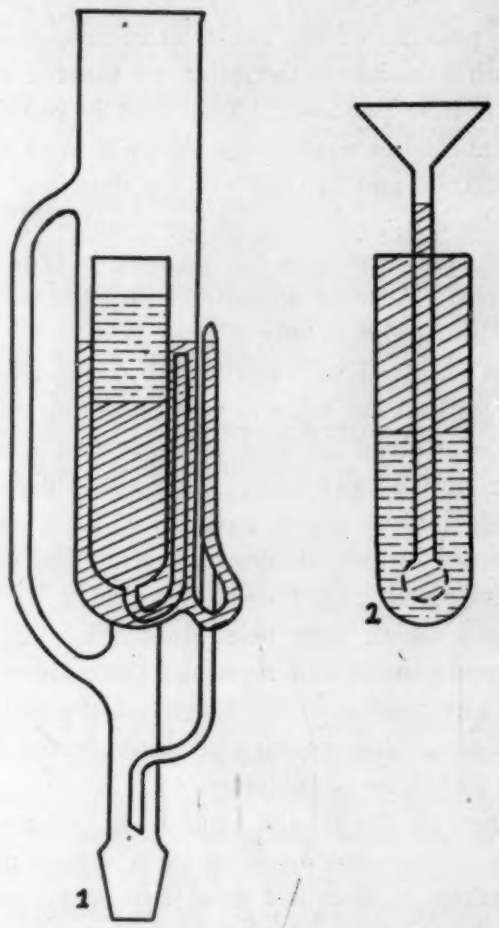

FIG. 1. Soxhlet apparatus equipped with an adapter for extraction of aqueous solutions with solvents heavier than water. The solvent is indicated by the sloping lines.
FIG. 2. An adapter for the extraction of aqueous solutions with solvents lighter than water. The solvent is indicated by sloping lines.

to include the extraction of aqueous solutions by immiscible solvents heavier or lighter than water. Both can be assembled by almost any laboratory worker.

Fig. 1 shows the Soxhlet extractor equipped with an adapter for the extraction of an aqueous solution with a heavy solvent such as chloroform. The adapter is constructed by sealing a length of glass tubing to the bottom of a test-tube of the desired width and then bending it around as described in the figure. The height of the bent outlet tube should be less than that of the body of the adapter. It need not be higher than the siphon of the Soxhlet extractor. To carry out such an extraction the heavy solvent is first introduced into the adapter to about the half-way mark and then the solution to be extracted is layered on top of this until the solvent comes out of the outlet side tube. The apparatus is now ready for use as in a regular Soxhlet extraction. When the chloroform which has condensed, percolated through the aqueous solution and has been forced out through the side arm reaches the level of the siphon it is returned to the extraction flask.

Fig. 2 illustrates an adapter for extraction with solvents lighter than water. This consists of a tube or vessel of any convenient height, depending on the amount of solution to be extracted, which will fit into the body of the Soxhlet extractor. The tube is equipped with a funnel whose diameter is slightly smaller than that of the extractor. For extraction the solution is introduced into the tube or vessel and the funnel is inserted. Extraction is now carried out as in the usual Soxhlet extraction. The condensing solvent drops through the funnel and percolates up through the solution. When the height of the solvent in the Soxhlet reaches that of the siphon it is returned to the extraction flask. The height of the vessel can be greater or less than the height of the siphon and is therefore adaptable for the extraction of small amounts of solution. For more effective extraction the funnel may be equipped with a perforated glass bulb in order better to distribute the solvent through the solution.

The adapters can be used in micro Soxhlet extraction apparatus as well as in the usual laboratory size apparatus.

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BOOKS RECEIVED

ERDTMAN, G. *An Introduction to Pollen Analysis.* Illustrated. Pp. xv + 239. Chronica Botanica. $5.00.
HOUGEN, OLAF A. and KENNETH M. WATSON. *Chemical Process Principles. Part One: Material and Energy Balances.* Illustrated. Pp. xii + 452. John Wiley and Sons. $4.50.
KERN, WILLIS F. and JAMES R. BLAND. *Geometry with Military and Naval Applications.* Illustrated. Pp. vii + 152. John Wiley and Sons. $1.75.
POWERS, PAUL O. *Synthetic Resins and Rubbers.* Illustrated. Pp. v + 296. John Wiley and Sons. $3.00.
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